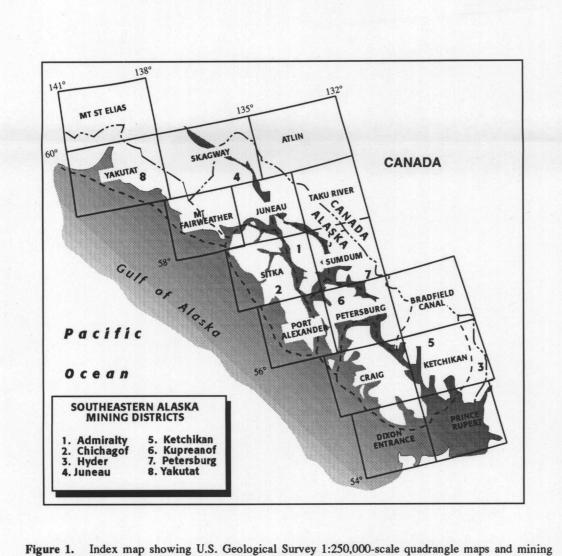


Physiography compiled in 1992 Edited by C.L. Ostergren; prepared by L.M. Ghequiere

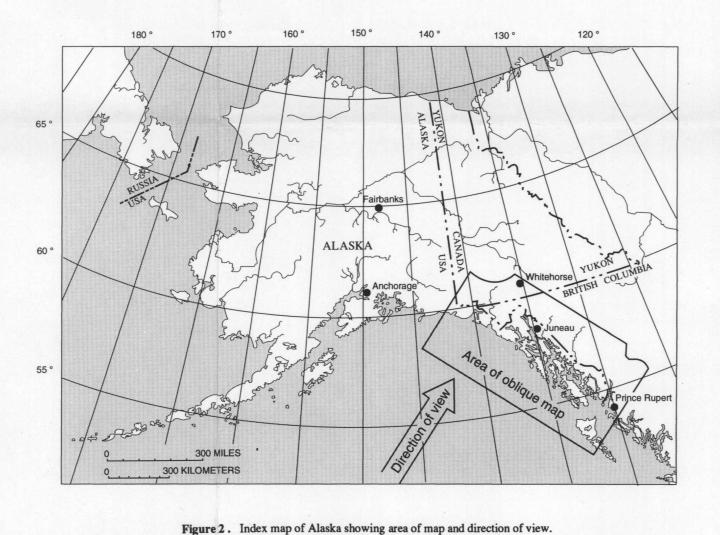
Manuscript approved for publication May 16, 1994

VERTICAL SCALE
IN METERS
20,000
15,000
10,000
5,000
HORIZONTAL SCALE IN KILOMETERS

HORIZONTAL SCALE IN KILOMETERS



districts of southeastern Alaska of Ransome and Kerns (1954).



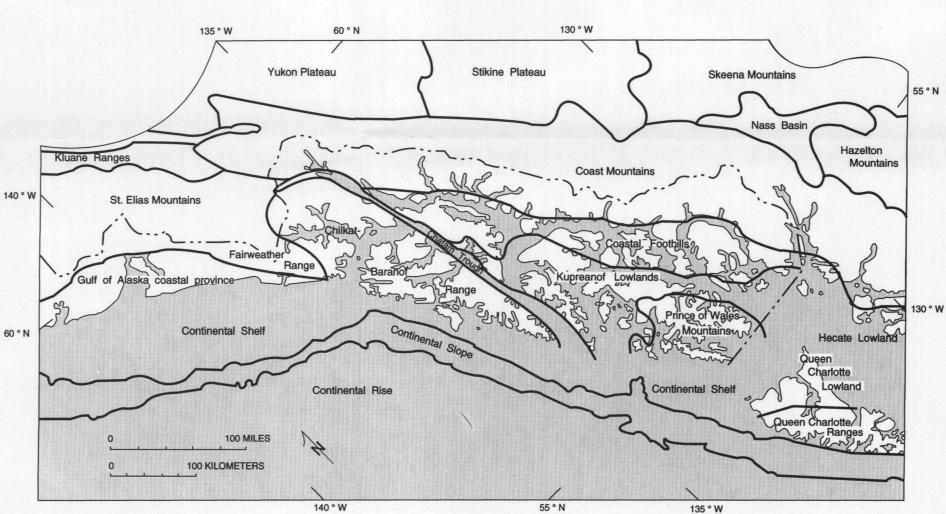


Figure 3. Physiographic divisions of oblique map area. Sources: Alaska, Wahrhaftig (1965); Canada, Bostock

INTRODUCTION

The text with sheet 1 describes the physiographic features and provides a summary of the geology of this area. The geology and mineral resources of the region are described in more detail on sheet 2. The main purpose of maps of this type is to portray characteristics of land features. Many place names used in accompanying texts are therefore not shown on the oblique maps in order to avoid interference with the portrayal of physiographic features. Place names are readily available on many other regional maps of the area.

Southeastern Alaska, also known as Alaska's panhandle, lies between Canada (Yukon Territory and British Columbia) and the Gulf of Alaska (fig. 1). About 80 percent of this vast region, which is about two-thirds the size of California, lies within the Tongass National Forest and is managed by the U.S. Forest Service. The political importance of the region dates to 1806 when Tsar Paul I transferred the headquarters of the Russian-American Company to Sitka, under Alexander Baranof's governorship, and continues to today with the 1959 entry of Alaska into statehood and establishment of Juneau as its capital.

Southeastern Alaska is endowed with scenic and wildlife features rarely paralleled elsewhere on Earth. Lush temperate rain forests of spruce and fir cover coastal lowlands of the nainland and islands (such as Baranof, Chichagof, and Prince of Wales) of the Alexander Archipelago, although many of these areas are now partly to extensively logged. About 45 percent of the region has been set aside for preservation of its wild land character and particularly for protection of native wildlife. These preserves include Glacier Bay National Park and Preserve (3.3 million acres) of northern southeastern Alaska and Wrangell-Saint Elias National Park and Preserve (13 million acres) northwest of Yakutat Bay and extending into east-central Alaska; these are among the nation's largest national parks. Smaller preserves include Russell Fiord Wilderness, Admiralty Island National Monument Wilderness, West Chichagof-Yakobi Wilderness, Tracy Arm-Fords Terror Wilderness, Stikine-LeConte Wilderness, South Baranof Wilderness, and Misty Fiords National Monument Wilderness. Much smaller preservation areas include Tebenkof Bay, South Prince of Wales, Coronation Island, Warren Island, and Maurelle Islands Wildernesses. The Forrester Islands National Wildlife Refuge protects well-known nesting-bird and sea-lion rookeries, and the Admiralty Island National Monument Wilderness protects a largely pristine environment for habitat of the large grizzlies known as the "Alaskan brown bear." The government of British Columbia in 1993 established a new Tatshenshini-Alsek Provincial Park (2.3 million acres) in the northwestern part of the map area that, combined with adjoining park lands of Canada and Alaska, comprise the world's largest managed coextensive wilderness area extending continuously from Glacier Bay and northward across parts of the Yukon and British Columbia and into eastern

Alaska; this wilderness area precludes development over an area totaling 25 million acres. Southeastern Alaska is also an area well endowed with mineral wealth; it contains about 1,000 identified ore deposits and prospects. Its long history of prospecting and mining is particularly well recorded by its immense past production of ores, principally gold, although few mines are presently in operation. Further development of southeastern Alaskan mineral resources, as well as current timber production, is now coming under increasing conflict with other usage of the land, particularly preservation of wilderness habitat. Development of known mineral deposits of Glacier Bay and other areas of southeastern Alaska (Brew and others, 1991) and of newly found copper deposits of the Tatshenshini River area, for example, are now precluded by the establishment of wilderness parks. Tourism, on the other hand, ranks now as a principal commodity of these areas, although ever- increasing numbers of visitors also bring environmental concerns. This map portrays southeastern Alaska in an oblique view toward the northeast (fig. 2) of an area stretching more than 650 km (400 mi), from Icy Bay on the north to Dixon Entrance on the south. The map of Alpha and others (1980) shows southeastern Alaska's physiographic setting in northwestern North America and the Gulf of Alaska. Access to the map area is by boat or aircraft only, except for roads leading to Skagway, Haines, and Hyder from Yukon Territory and British Columbia. A general description of southeastern Alaska and its ten thousand years of human history are given in The Alaska Geographic Society (1993). Descriptions of many parts of the region are provided by The Alaska Geographic Society (for example, 1982, 1988, 1990, 1991).

U.S. Geological Survey (USGS) topographic quadrangle maps of 1:250,000 scale that cover this region are shown in figure 1. USGS maps of 1:63,360 scale (1 inch = 1 mile) are of larger scale and are recommended for locating mining areas and prospects that are described on sheet 2.

The techniques used to prepare this oblique map of southeastern Alaska and the interpretation of maps of this type are described by Alpha and others (1988). Distances on the oblique map can be scaled in any orientation to true distances using the semicircular scale diagram: the distance measured between two points on the map is measured along a parallel direction in the scale diagram, from which the true distance is read. The topographic maps from which this diagram was prepared are those of 1:1,000,000 scale published by the Canadian Department of Energy, Mines and Resources (1969) and by the U.S. Geological Survey (1956, 1976), and of 1:250,000 scale by the Geological Survey of Canada (no date).

## PHYSIOGRAPHY AND GLACIERS

Alpine scenery of exceptional variety characterizes southeastern Alaska. Large expanses of ice near the crest of the Coast Mountains, such as the Juneau and Stikine Icefields, feed large valley glaciers, such as those in glacier Bay National Park and Preserve and the Malaspina Glacier that reach tidewater where icebergs are spawned. Deep valleys and fiords such as Yakutat Bay, Taku Inlet, Chatham Strait, Atlin Lake, and Frederick Sound were carved by past valley glaciers that are now in retreat or that have disappeared (Molenaar, 1990).

Much evidence indicates an immense thickness of glaciers of the past when they covered far more territory than today's (Coulter and others, 1965). The front of an ice shelf at the mouth of Glacier Bay prevented early explorer Capt. George Vancouver's 1794 entrance into the bay — a bay that today is traversed throughout by large tourist vessels. The history of glaciation from more than 13,000 years ago to the present of the Glacier Bay region is given by Powell (1984). The presence of ancient shorelines that are now well above sea level in Glacier Bay and elsewhere provides evidence that the Earth's crust in these areas was uplifted by rebounding from the unloading of the burden of the great volume of ice as the glaciers retreated. Tectonic processes, active throughout much of the geologic past, also contributed to the uplift of the crust in this region.

The map shows two principal types of physiography: (1) the Coast Mountains with adjoining upland areas of mainland North America, and (2) the insular region of the Alexander Archipelago along the Gulf of Alaska, in which the largest islands are Baranof, Chichagof, Admiralty, Kupreanof, and Prince of Wales. The smaller physiographic divisions shown in fig. 3

(sheet 1) and their descriptions below are from Wahrhaftig (1965).

The St. Elias Mountains (fig. 3) along the Alaska-Yukon Territory border contains some of the most spectacular mountains of North America, rising across Alaskan coastal lowlands of Pacific shores to altitudes of 5,800 m (19,000 ft). The mountains abound with jagged, ice-carved scenery and are swathed by a nearly continuous network of glaciers and icefields.

Alaska's Fairweather Range rises abruptly from the Pacific Ocean to heights of 3,700 to

4,600 m (12,000-15,000 ft), forming an unbroken barrier between the ocean and Glacier Bay. On the international border the highest point, Mt. Fairweather 4,665 m (15,000 ft.), is the highest mountain in British Columbia. Turbulent glaciers and icefalls cascade toward the ocean and bay, several reaching tidewater to spawn icebergs.

The Gulf of Alaska coastal section is a lowland plain crossed by several large rivers and lies below immense escarpments of the St. Elias Mountains and Fairweather Range. The enormous Malaspina Glacier, a piedmont-type glacier shown in Alpha's (1975) diagram, reaches from the

Pacific Ocean to Mt. St. Elias. Marine terraces that extend to 240 m (800 ft) in altitude are evidence of recent uplifting, caused by tectonic and glacial unloading of the crust.

The Chatham Trough (Wahrhaftig, 1965) is a mostly submerged trench 6.4 to 24.1 km (4-15 mi) wide extending northward from the Gulf of Alaska along Chatham Strait and Lynn Canal to the town of Haines. The trench follows the trace of one of southeastern Alaska's major transcurrent fault systems, the Chatham Strait Fault, which extends northward and may join the Denali Fault of central Alaska (Page and others, 1991).

The Kupreanof Lowland (Wahrhaftig, 1965) consists of subdued, strongly glaciated terrain of islands laced with intricate waterways. Rounded mountain summits rise to elevations of only 610 to 910 m (2,000-3,000 ft).

The Chilkat Range and Baranof Mountains region consists of, from north to south, the rugged, glaciated Alsek Ranges of 1,220 to 2,300 m (4,000-7,500 ft) elevation near Yakutat; the generally low lands with rounded mountains of the eastern part of Glacier Bay; the Chichagof Island region of fiords and subdued mountain ridges and summits rising to 910 to 1,070 m (3,000-3,500 ft) elevation; and the fiord-indented Baranof Island with its chain of rugged peaks rising to

elevations of 910-1620 m (3,000-5,300 ft).

The Prince of Wales Island region contains moderately rugged, glaciated mountains with rounded summits 610 to 1,070 m (2,000-3,500 ft) in elevation and a few higher spires. U-shaped valleys and fiords cut the mountain terrain. Karst topography is developed locally on areas underlain by marble.

The Coast Mountains are a rugged, glaciated upland of generally 1,500 to 2,130 m

The Coast Mountains are a rugged, glaciated upland of generally 1,500 to 2,130 m (5,000-7,000 ft) elevation, with spires and blocky peaks along the international boundary reaching 2,516 m (8,584 ft) at Devils Paw on the boundary east of Juneau and 2,767 m (9,077 ft) at Devils Thumb on the boundary east of Petersburg. The Juneau and Stikine icefields are two of the largest icefields in North America and feed major outlet glaciers (Taku and Le Conte Glaciers) that reach to the sea. Most glaciers of this region appear presently to be in a state of recession.

PHYSIOGRAPHY AND TECTONICS

The oblique map shows relations between some physiographic features and effects of Cenozoic tectonic activity of the region. The most obvious physiographic feature is the markedly linear north-trending trough of Chatham Strait. Chatham Strait marks the trace of a dextral (right-lateral slip), transcurrent fault that shows about 190 km (120 mi) of separation (Ovenshine and Brew, 1972). The fault (sheet 2) continues northward and may connect with the Denali Fault of south-central Alaska (Lahr and Plafker, 1980; Page and others, 1991). The Chatham Strait Fault shows little modern seismic activity (Page and others, 1991; Rogers and Horner, 1991).

The Fairweather Fault along the continental margin (sheet 2), in contrast to the Chatham

Strait Fault, is a highly active transcurrent dextral fault with strong recent and present seismicity (Lahr and Plafker, 1980; Page and others, 1991). South of Cross Sound, the fault approximately marks the edge of the continental shelf (Carlson and others, 1985) and farther south is coextensive with the offshore Queen Charlotte Islands Fault, which is the locus of most major seismicity of western Canada (Rogers and Horner, 1991). Northwestward from Cross Sound the fault tracks inland, crossing the heads of Lituya and Yakutat Bays and continuing into southern Alaska. A major earthquake in 1958 on the Fairweather Fault resulted in an immense landslide into Lituya Bay that caused a devastating giant wave to sweep the bay, as described by Miller (1960) who reported evidence of earlier similar enormous wave activity in the bay. Activity along the Fairweather and related faults is the result of tectonic interaction between the North American and Pacific plates that shows an unusually high rate of motion of about 5.8 cm/yr (2.3 in/yr) of the Pacific plate northward relative to stable parts of North America (Lahr and Plafker, 1980).

The oblique map also shows relations between some offshore physiographic features and onshore ones not previously recognized for this part of Alaska. The continental slope of the northern Gulf of Alaska differs from many other continental slopes in its lack of large submarine canyons (Carlson and others, 1990). The largest submarine canyon shown in this map area is a northeast-trending valley about half way between Chatham Strait and Dixon Entrance. It is here named Klawock Canyon after a village on Prince of Wales Island near its head. The canyon appears to be the northern main tributary to the offshore Mukluk Channel system of Bruns and others (1992). Klawock Canyon appears to lack a major onshore drainage system to which it might be erosionally related. The major apparent drowned river and glacial valleys of Dixon Entrance and Chatham Strait, conversely, do not show any significant correlative canyons offshore at the scale of this map. These relations resemble those along similar tectonically active coasts (of California) with transcurrent faults that show onshore and offshore valleys offset by faulting and resulting in "beheaded" submarine canyons (Greene and others, 1991). The more detailed maps of Bruns and others (1992) show many small-scale features of offsetting within a channel network of their Mukluk Channel system across the active trace of the Queen Charlotte Fault off Dixon Entrance, as well as of offsetting of turbidite channels near the entrance to Chatham Strait. Their portrayal of channel displacements off Dixon Entrance shows clearly the effects of recent right-lateral activity along this fault and they also describe many structural features related to the faulting. The displacement of other submarine canyons from onshore river drainages to which hey may be related by erosion can be explained by strike-slip movement along plate-margin faults Greene and others, 1991), like those of this area of Alaska. Beheaded valleys and offset drainage channels are well known along California's active, transcurrent San Andreas Fault (Wallace, 1990). The high fault-slip rate on the Fairweather Fault (5.8 cm/yr, Lahr and Plafker, 1980) if continued long into the past would result in large separation across the fault. We accordingly suggest that Klawock Canyon may have been incised by a drainage outlet from Dixon Entrance and subsequently offset by about 120 km (75 mi) of northward transcurrent dextral faulting along the fault system, which is a distance similar to one given by Bruns and others (1992) for maximum offset of the north arm of the Mukluk Channel system. Fault systems and offshore channel patterns of the map area are far more complex than shown simplified at the large scale of our map (see

Bruns and others, 1992). Although the fault trace as shown on sheet 2 lies about 15 km (9 mi)

seaward from the head of Klawock Canyon, the fault is an at least 15-km-wide zone containing

multiple traces of dextral slip (fig. 4, of Bruns and others, 1992). Using the slip rate given by Lahr

and Plafker (1980), the Klawock Canyon would have been offshore from Dixon Entrance about 2

m.y. ago (see also Bruns and others, 1992).

The continental shelf of this part of the Gulf of Alaska is conspicuously narrow south of Cross Sound, where the orientation of the continental slope closely parallels the Fairweather and Queen Charlotte Islands Fault system (sheet 2). The shelf broadens markedly and the continental slope curves away from the Fairweather Fault north of Cross Sound (sheet 2). The principal offshore valley features of Yakutat, Alsek (Alsek Canyon of Bruns and others, 1992), and Yakobi Valleys, from north to south, are described by Carlson and others (1982). As shown on sheet 1, the arcuate Yakutak Valley and Alsek Valley head near obvious sources of Yakutat Bay and Alsek River drainage systems. Similarly, the broad Yakobi Valley is situated directly offshore from an apparent source drainage system of Cross Sound.

The Yakutat Valley at the north — farthest from the Fairweather Fault system — shows

The Yakutat Valley at the north — farthest from the Fairweather Fault system — shows no effect of fault activity in its Quaternary deposits, and little effect of tectonism is recorded in young deposits of Alsek Valley (Carlson and others, 1982). Development of Yakobi Valley, on the other hand, appears to be continually affected by the Fairweather Fault (Carlson and others, 1982), but fan- and channel-deposits of the valley farther offshore show no evidence of offsetting (Bruns and others, 1992).

The apparent 120 km of offset between major offshore and onshore physiographic features near Dixon Entrance described above suggests that features elsewhere across the Fairweather Fault system might also reflect offset of this magnitude. Although Yakutat, Alsek, and Yakobi Valleys are closely related to present onshore drainage systems, early stages of their development are possibly related to other drainage systems, such as Yakutat Valley to Alsek River, Alsek Valley to Cross Sound and Yakobi Valley to some unknown earlier river system north of Sitka — each 100-120 km distance apart. The unknown rocks of the tablelike submarine plateau on the southeast side of Yakobi Valley might consist of some part of the Quaternary Mt. Edgecumbe volcanic field of Riehle and others (1989) that was offset by about 100 km of right-lateral slip across the intervening Fairweather Fault (sheet 2). Present knowledge of the erosional history of this region, however, is insufficient to test these suggestions. Late-Cenozoic glacial advances and retreats related to sea-level changes would have influenced these early drainage systems. The absence of an offshore canyon about 120 km north of the mouth of Chatham Strait (near Mount Edgecumbe) that might relate to Chatham Strait drainage may be accounted for by faulting or by volcanic activity at this narrowest part of the continental shelf.

The youngest known unit in near-offshore and onshore areas, both here and in nearby parts of the Gulf of Alaska, is the 5-km-thick glaciomarine Yakataga Formation of Miocene to Holocene age (Plafker and Addicott, 1976; Carlson, 1989; Eyles and Lagoe, 1990). In the map area the Yakataga is exposed onshore near Icy Bay, Yakutat Bay, and near Lituya Bay. These deposits presumably make up much of the near-surface offshore regions of the map area, and possibly also occur in the area of Dixon Entrance. Submarine Holocene materials probably include deposits of end moraines near present or former valley-glacier termini such as those identified by Carlson and others (1982) and Carlson (1989) and that appear to be shown by the topography near the mouths of Dixon Entrance, Chatham Strait, and Cross Sound (sheet 1).

## DIED ALC AND CROLOGY

MINERALS AND GEOLOGY

The lure of gold brought prospectors and miners by the thousands to Alaska and the Yukon in the later 1800s. Southeastern Alaska is rich in the lore of discovery and development of its gold mines — Juneau's Alaska-Juneau (A-J) and the nearby Treadwell, and the Chichagof and Hirst-Chichagof near Sitka. Skagway soon became the gateway to rich Yukon gold fields. In the fall of 1880, prospectors Richard Harris and Joe Juneau panned their way up Gold Creek eventually to locate Alaska's first major gold strike near the town now bearing Joe's name. However, credit for the discovery was probably earned by the Auk tribe's Chief Kowee, a Tlingit native, who led Harris and Juneau to the gold lode outcrops (Herbert, 1990). Scientific studies, largely by the U.S. Geological Survey, followed soon after these discoveries (referenced in Buddington and Chapin,

Pioneering geologic investigations of all of southeastern Alaska that began in the early 1900s focused on understanding the geologic setting of its many lode gold-bearing regions. One the Juneau gold belt, with varying amounts of silver, is a well-defined 8- to 16-km-wide (5-10 mi) zone extending northwestward for 280 km (175 mi) from Thomas Bay to Lynn Canal (Buddington and Chapin, 1929). The concentrations of mines and prospects of this belt along the western part of the Coast Mountains are shown on sheet 2. Another, the Chichagof gold belt of the western part of Chichagof Island, contains one of southeastern Alaska's largest and most famous former mines, the Chichagof, as well as several other smaller producers of the past. Production from southeastern Alaskan mines (most were closed before World War II) totaled nearly \$2.5 billion (Brew and others, 1991). Until recently, Greens Creek Mine on northern Admiralty Island (JU-2, sheet 2) which contains large reserves of silver, gold, lead, and zinc (Brew and others, 1991) was the largest operating mine, but with brief production starting in 1989 and ceasing at least temporarily in 1992. Southeastern Alaska is part of western North America's Cordilleran orogenic belt, with which it shares a record of unusual geologic complexity and a lengthy history from as long ago as the early Paleozoic (500 million years ago) and possibly earlier. Continuing geologic activity is shown by ongoing crustal uplift, recent volcanism, and occasional earthquake activity along such major zones as the Fairweather and Oueen Charlotte Islands Fault systems along the continental margin and the lesser seismic activity of other areas in Glacier Bay and near Haines. The geology and mineral resources of this area is are discussed in more detail on sheet 2 Conner and O'Haire (1988) provide a general-interest description of the geology along the few roads and the major boat routes of the Inside Passage through southeastern Alaska.

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